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ABSTRACT

To clarify delivery system concepts, several topics will be addressed: educational needs of lower-income older people, formulation of a design concept, specification of the system's concrete aspects, and research/development implications. As the proportion of persons over age sixty-four grows and sensitivity to unmet lifelong learning needs rises, the need for conscious design of lifelong learning institutions increases. A service system should have linking mechanisms that attend to the individual's total life situation. The delivery system can be identified as an interactive, self-regulating, three-component system: (1) a sensor receiving environmental information, (2) a transducer utilizing information to generate and prioritize alternatives, and (3) an effector converting alternatives into operational programs. Linkages at the interface between sensor and effector contribute to the system's cybernetic potential. Persons participating in the delivery system along the interface are potentially significant reference persons for unreached persons in the environing society. System relationships can be conceptualized in seven phases: program anticipation and verification, data collection, academic programming, budget, administrative organization, implementation, and formal evaluation. It is proposed that theory-based method can serve dialectically to link conceptual design and the action of implementation. Disciplined inquiry into the development of design theory and delivery systems grounded in theory-based method is needed. (CSS)

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DESIGN OF EDUCATIONAL DELIVERY SYSTEMS FOR LIFELONG LEARNING

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Introduction

This paper grows out a seminar on "Design of Educational Delivery Systems for Lifelong Learning."¹ The seminar seeks to clarify the concept of design and related generalizations. It is assumed that the conceptualization will be helpful in the formulation and administration of educational delivery systems generally and, more specifically, those intended to serve lower-income, older people.

The task has turned out to be no small one. There are many persons who are involved in delivering educational services. For the most part they get on with the task at hand in common-sense ways. That posture is probably just as well, if something is to be done about crucial problems-at-hand. If, however, there is some usefulness in knowing why we do this rather than that, an analytic examination of the underlying concepts and related assumptions and how they relate to cost-effective design and administration of educational delivery systems makes some sense. Such is our assumption.

This paper will first give a general perspective on adult educational needs as a basis for defining potential learners and raise some questions about conventional delivery systems. We shall then go on to formulate a concept of design and its components as they interface with the complex and changing needs of the social environment. The process of specification of general design principles to more concrete aspects of educational delivery systems will then be outlined. Finally some implications for further research and development will be explored.

Background and Perspective

Aging is a growing characteristic of industrialized societies. An index of aging is the ratio of persons age 65 and older to those under 15.

That ratio is increasing for all developed countries. Behind that trend is the social fact of declining birth rates. The fact that birth rate in the United States increased after World War II did not change the course of the general trend; the index of aging in 1900 was 11.9, in 1920, 14.8, in 1940, 27.2 and by 1960 was 29.7. With declining fertility after 1960, the index increased more rapidly reaching 34.4 in 1970.

Aging seems to be one of the characteristics of social and economic modernization. Cowgrill and Holmes² state an inverse relationship between status of aged and the degree of modernization characterizing the social setting. It should be noted that not all students of aging agree with this proposition.

Usually this decline in prestige is explained by reference to changes in social relationships caused by the introduction of new technology. With the development of an industrial economy and its accompanying specialization of knowledge and productivity, the aged have not kept pace in "retooling" their skills. In terms of social exchange theory, the aged possess fewer marketable skills and current information to use as "exchange" resources in societal interactions. Knowledge and control gained by years of experience no longer represent "useful barter" in economic and social exchange; under such conditions, aging leads to relative deprivation of current life resources.

Problems of aging are seen, in part, as problems of decreasing power resources. Because power resources decline with increased age, older persons become progressively less able to enter into balanced exchange relations with other groups with whom they are in interaction. This process is the result of a series of exchange relations in which

the relative power of the aged, vis-a-vis the younger exchange partner, progressively deteriorates. An imbalanced exchange ratio results when the aged are forced to exchange compliance--the most costly of all generalized reinforcers--for their continued sustenance.

Although older adults are increasing both in numbers and as a proportion of the total American population, they are participating in adult learning opportunities at a relatively low rate compared to the young of the population. Barriers older adults may face include inadequate transportation, lack of money, poor health, the scheduling of programs and the attitude that learning is for the young and the intellectual. Delivery systems are geared primarily to the first two and a half decades of life.

Adult students frequently possess many strengths, insights and understandings, but these are all too often not taken advantage of in the design of educational and training programs.

Educational progress for disadvantaged adults may be slow and it is easy to become discouraged. Since many students come at night, often with no stipend and after working all day at low level jobs or after caring for a home and children, they must be able to manage the many life problems that occupy their time and energies, if they are to persist with the program. While some are able to maintain the strong conviction that the sacrifice is worth the chance to better themselves, and are thus able to keep a positive balance between reasons for coming and reasons for dropping out; others are not. The balance is always precarious, and the burden placed upon adult education programs is great. Unless the student's motivations for coming are strengthened by the program with visible signs of progress toward goals, and unless there

is help with the life problems that beset the learner, there is the prospect of having to leave.

In his effort to demythify conventional educational delivery system assumptions, Kurland³ has proposed A National Strategy for Life Long Learning. He begins by identifying eleven basic assumptions that "most persons familiar with adult learning probably share" as the following:

(1) We know that most learning that people do occurs without any "education"....

(2) We know that when we do try to educate, sometimes no discernible learning occurs, and often the outcomes are not what we desired or intended....

(3) We know that development does not end when we become adult but continues throughout life....

(4) We know that society is no longer stable....

(5) We know that the rate of growth in knowledge makes impossible the accumulation in youth of intellectual capital that will serve through life without being replenished.

(6) We know, in any case, that it is not just the content of what we learn but the skills and attitudes that are important, and these are never learned once and for all; they develop continuously in response to changing life circumstances.

(7) We know that while some of us learn to learn at an early age and keep on learning throughout life, most of us, from time to time, do need help.

(8) We know that those who have had the most education tend to get more.

(9) We know, moreover, that those who have the most education tend to get better jobs, have higher incomes, and report better health and happiness (though the exact connection is not clear).

(10) We also know that no society, ours included, has done very well with those who are disadvantaged at birth....

(11) We know that millions of adults enjoy learning, participate actively in a tremendous array of formal and informal learning activities, and spend their own money to do so.

Kurland next identifies several problem areas in his comprehensive lifelong learning strategy and prospects for their rational solutions. In discussing our failure to attain an equal educational opportunity as a basic objective of our present system, he notes that we place too much reliance upon obtaining all our education at once, that the quality and quantity of our education is directly tied to family wealth, and that failure has a dramatic effect upon us. Kurland proposes that we develop a flexible educative system, with formal learning intermingled with work experience over a longer period of time. This system would allow for "late bloomers" to develop more easily and for easier change of vocation after sampling of various areas.

The above mentioned mixing of alternate sessions of work and formal education would also allow for less labor shortages as a quick "retooling" of skills could produce new labor forces to match emerging technologies. Another benefit of this procedure would be the lessening of the shock of entering the "world of work" from the womb-like world of education. By alternating educative experiences with those of the working world, the values of each would be intertwined.

Kurland argues that our post-secondary educative structure should "move away from the emphasis on terminal degrees" and toward the concept that learning is valuable in and of itself, that it is useful in providing a foundation for more learning and that it is a definite asset in achieving one's career and personal goals.

So far it has been contended that ours is an aging society in which processes of modernization, while fostering an aging population, create problems for the aging that, among them, result in an association in later years between declining social influence and aging. At the same

time institutions that grew up to serve a society with a much lower index of aging are slow to adapt to the changed social conditions and proposals are appearing that advance strategies of adaptive action. Adaptation is hampered by beliefs or "myths" which become self-fulfilling.⁴

A great deal of the isolation of elderly people from social and intellectual activities has been due to acceptance, by both young and old, of the popular idea that old age and incompetence invariably go hand in hand. That such a popular stereotype of the elderly person exists is no doubt due to a literary and traditional legacy handed down from a period in which life expectancy was much shorter, the conditions of living harder and the possibility of reaching three score and ten without serious mental and physical limitations was confined to a small fraction of the population. Literary sources, from fairy tales and nursery rhymes to Shakespearian drama, almost universally emphasize the disadvantages of old age.

Old age places limitations on the performance of the individual; the magnitude of these has usually been all too readily exaggerated (even by the elderly themselves) without any experimental evidence of just what the quantitative effect of these limitations might be. "The old grey mare, she ain't what she used to be" goes the song, or "You can't teach an old dog new tricks." These and many other literary stereotyping phrases abound in our culture.

Because of the stereotypes about old age, older Americans both hinder themselves and are hindered in participating actively as wage-earners, volunteer-workers, neighbors, and as sources of wisdom in the mainstream of American life.

Contrary to popular belief, learning ability does not decline significantly with age. In the absence of brain disease, older people are not notably more forgetful than younger people. Depression is an unfortunate fact in American life, not a peculiarity of the aged. Old "neurotics" are no more infantile than young "neurotics." The majority of older people are not "set in their ways." They are remarkably adaptable. They have learned to be. They have lived through more technological and social change than any other group in history--from the age of the horse and buggy to that of supersonic transport.

Against this background and perspective, we now turn to implications for design of educational delivery systems. Attention will first be directed to some underlying assumptions.

Design Assumptions

The above review sets in stark perspective the crucial role of social, psychological, economic and epistemological assumptions in shaping conventional educational delivery systems. As already pointed out, Kurland⁵ has identified several assumptions about what is known about lifelong learning. Those assumptions point to discrepancies between what is known and what is done. A still more radical criticism of traditional educational institutions has been made by Suchodolski.⁶ The many observations by students of educational institutions and by concerned practitioners of education point up the gaps which exist between the needs met by the practice of delivering educational services and those posed by the variety and complexity of changing educational functions across the life span. Assumptions about when, where, how and what in delivery underscore the need to go back to basic ideas about

means, time, place and content. Thus we start with the assumption that an examination of the concept of design has to go back to the most elementary notions upon which it is based. It is hoped that such radical analysis will enable a clearer assessment of both existing and potential educational systems.

It may be instructive to start with the basic difference between natural and human systems, for example, the difference between a solar system and an educational delivery system. The former is the sort of system with which the natural sciences have been notably successful in development of methods of making reliable explanatory and predictive statements. Thus we have built up a substantial body of "objective," "hard," "reliable" knowledge about natural systems. Human systems take on their distinctive nature because they are made by human beings. The typewriter in front of me is a human system in this sense; it has been invented by human beings and has a function or utility which enables me to place these words on paper. Its components are relatively simple; they also make use of certain elements of "natural" science, e.g., knowledge of levers, electricity, and the like. But the person using the typewriter does not need to have mastered all, or even an important part, of that knowledge in order to make productive use of it. Indeed the primary determinants of the range and complexity of usage are in the environment; many different persons with very different purposes in mind can use it for arranging symbols in ways that may be simple or complex and the range can be increased by the simple expedient of substituting typeheads useful in mathematics or foreign languages. Thus, at the interface between the relatively simply designed human system, typewriter, and the environment (the most proximate complex component

being the user) there can emerge a very extensive complexity in usage.

The point is that a relatively simple human system designed for a particular purpose or usefulness (utility) can be an instrument of a wide variety of environmental needs.

The above example is but one of possible human systems; it is a concrete, material system. A blueprint would be a more abstract (in the sense that it abstracts out those aspects of immediate relevance) human system. A system design is just such an abstract human system.

A concrete social system, instead of having components made of "natural" materials, is made up of human beings and may be thought of as a "human" human system. That is a rather cumbersome expression. It is useful, at this point, to draw upon the usage of Simon⁷ and call man-made systems artificial systems. The expression human systems will be reserved for those artificial systems whose primary components are human beings.⁸

The human system introduces a new level of intentionality. We have noted that artificial systems are man-made for a purpose (intentional). A human system has, by definition, purpose or intention; the component human beings have their own intentions also. Thus human systems are intentional systems with intentional beings in them. This fact adds a new level of self-awareness within human systems that permits an additional level of self-and shared-consciousness that enables parts of the system to be conscious of themselves and the system and to modify intention through that awareness. The typewriter cannot be conscious of my intention to use a different typehead; a human system can use such consciousness of environmental need and become self-adaptive

to information about environmental complexity of that sort. Human system design can be expected to take into account the capacity of self-adaptation regarding the environment; human systems can be cybernetic.

The persons served by human systems are total human beings who do not turn up with neatly separated needs for education, recreation, health and social services and social adjustment. Rather, all these life concerns are woven together in the individual. Hence it is assumed that various types of human service systems, be they education or health or social service or other, need to have linking mechanisms that permit unified attention to persons in their total life situations.

Human System Design

Educational systems are seen as human systems with educational functions. Thus they can be viewed as systems that are relatively simple structurally interfacing in a potentially self-adaptive mode with a relatively complex environment. In its simplest terms, a human system may be seen in relation to its environment as consisting of (1) a component that obtains information from its environment, (input component or sensor), (2) a component that converts the information into function-related possibilities and makes a criterion-related selection (transducer) and (3) a component that conveys a response (information) to the environment (output component or effector).

An illustration may be useful. The range of environmental indicators of educational need upon which the sensor collects information will be of crucial importance to the transduction process and to the adaptive

competence of the system. A common practice is to rely in an important way upon environmental expressions of need through needs assessment surveys. To what extent does it permit special interest groups in the environment to overload information channels? Human systems also develop their own special interests, particularly as they relate to system maintenance. If an existing client group has gained special access to information channels and offer the prospect of system maintenance, to what extent may they be expected to exclude or prevent inclusion of information which could open up other alternatives? Are design limitations of these sorts related to the current fact that educational services get to be delivered to those who already are relatively highly educated and delivered at a much lower level to those who have relatively less education? These questions lead to specification of certain characteristics that are important to the three design components already identified and the interface with the environment. These characteristics will be known as "key design principles." Before proceeding to those principles some further attention needs to be given to the system-interface-environment relationship.

We have already noted two distinctive characteristics of human systems: (1) consciousness of potential environmental utility arising from the interface of the system with the environment (sometimes referred to as "desired states of affairs" or "goals" or "outcomes") and (2) consciousness of that consciousness. That awareness makes possible comparison of present states of affairs with intended states of affairs and specification of present-intended gap. These characteristics make possible sensor collection of information based upon utility-related environmental indicators, defining present state at

time one (ps_{t1}) and intended state (is), and their comparison with the state of the system at another time (ps_{t2}) providing an estimate of the change of the state (Δs) of utility realization. Stated briefly, $ps_{t1} \sim ps_{t2} = \Delta s$. Thus the sensor is in a position to obtain information on environmental modulation⁹ resulting from the intervention of the effector, process it through the transducer and modify effector intervention in the light of that information. This relationship provides an artificial intelligence subsystem that makes possible a self-regulating or cybernetic human system. From here on the use of the expression 'human system' will imply cybernetic competence of this sort. Provision in design for system competence in sensing changes in the utility function and in responding to those changes is seen as essential to the definition of a viable human system. It is the present intent to promote design of viable human educational systems for lifelong learning.

The concept of utility merits further note. Information on the state of the system and state changes are matters of fact and subject to empirical examination; they lend themselves to scientific research that can result in theories about those environmental phenomena that can provide understanding and expectation. In turn, that knowledge can increase the reliability of effector interventions thus reducing the allocation of resources to less fruitful alternatives. In this sense the memory within the design can build theoretically upon experience and develop increasing competence in error-reduction and cost-effectiveness through identification of strategies that are more utility-effective.

Utilities refer to states of affairs that are not yet facts; they are part of what Whitehead has called "the light that never was on land

or sea." Apart from the fact that they are stated utilities, they are not part of the world of present fact; they are part of human aspiration, hope, valuing, desiring. They pose a normative domain alongside the factual domain. Theory-based expectations from the factual domain give us probabilities for outcomes of effector interventions. Theory-based expectations from the normative domain give us desirabilities for outcomes of effector interventions. This nexus of probabilities and desirabilities poses the old problem of fact-value or is-ought.¹⁰ Those effector interventions which have relatively high probability of leading to relatively high utility increments are seen as utility-maximizing interventions.

If the design system is to be utility-maximizing, there is a need for the transducer to generate a variety of alternatives for the effector thus providing a basis for identifying the more and less fruitful alternative strategies and for becoming a more utility-maximizing system.

There then arises the issue whether the alternative search is more fruitfully undertaken serially or in parallel or in mixed strategies. The value-probability products of serial interventions are likely to be less mutually "contaminating" than either parallel or mixed strategies. But the latter are less time consuming than the former. If time is a relatively important utility and the alternative(s) not too risky, then parallel variation of intervention may be indicated.¹¹ The points are that (1) a viable human system that is clearly utility-maximizing needs to be characterized by variety in its effector intervention capability and that (2) parallel interventions may be utility-maximizing.

The design components and characteristics of human systems, at the rather universalistic level at which they have been formulated here,

may seem too neat and perhaps, even, facile. It is a credible position. Such is the case because of the immense complexity of the environment and the interactions at the interface. The relatively low level of predictive power in the human sciences for specific situations combined with the technical problems of information storage and retrieval useful for effector response in utility-related form pose severe tactical action constraints. But there are positive prospects too. Despite the above limitations, the transducer may derive from the social sciences useful long-term or policy guidance and, with experience, may gain in tactical relevance. There are also the human minds available through persons working in the transducer component. If we understand Simon¹² correctly, information is stored in the form of relations among pieces and those persons who are expert in a particular area of experience, for example grand masters and masters in chess, can, after a short visual stimulus from actual games, reproduce them almost without error, while those with little expertness do much less well. The relationship did not hold for pieces arranged at random. It may be that persons who have developed expertness and have become, as we sometimes call them, "the memory of the system," particularly if there are expected patterns of information usage, can be useful in hypothesizing utility-maximizing alternatives. At least it would seem sensible to try to identify such able persons in or for the transducer and to draw systematically upon their competence. It would also seem reasonable to anticipate that such persons could make a contribution to the more permanent design of artificial intelligence. These considerations pose a highly important role for the administrator in viable educative human systems. There is the chance that they will manifest the quality which, later on in this paper, we shall find the Venerable Bede called "the grace of discretion."

The human system design model sketched so far is represented in Figure I.

Key Design Principles

Key design principles have already been defined as those general characteristics of the model shown in Figure I that help to assure its being viable and utility-maximizing. By definition, the controlling system concept is utility or a symbolic representation of a desired future state of affairs. Since resources are regularly in short supply, it becomes important to realize as much utility as possible with the least possible resources, i.e., to be cost-effective in utility-maximizing. Along lines similar to those proposed here, Johnson, Kast and Rosenzweig¹³ advance the following "characteristics of effective systems":

simplicity	reliability	acceptability
flexibility	economy	

Human systems of the type under consideration may be seen as "cost-effective, client centered service organization." Design principles for such organization have been formulated by Kochen and Deutsch:¹⁴

Our analysis, from the specified formal models reported here and from other considerations, leads us to propose that the following design principles underlie the organization of a cost-effective, client centered service organization:

(1) Communication channels should be two way, to facilitate feedback, and short, to allow for immediate responses.

(2) Communication channels, control units, processors, input-output terminals and memories should be protected against excessive cost of (a) errors, (b) abuses, and (c) overloading. Reserve capacities should distribute the costs of fixed capital installations and labor to minimize total cost.

(3) Wherever possible, decisions should be delegated downward to the lowest level where they can be adequately made, so as to increase participation.

(4) Clients and third parties substantially affected by the outcome should be involved in the making of decisions.

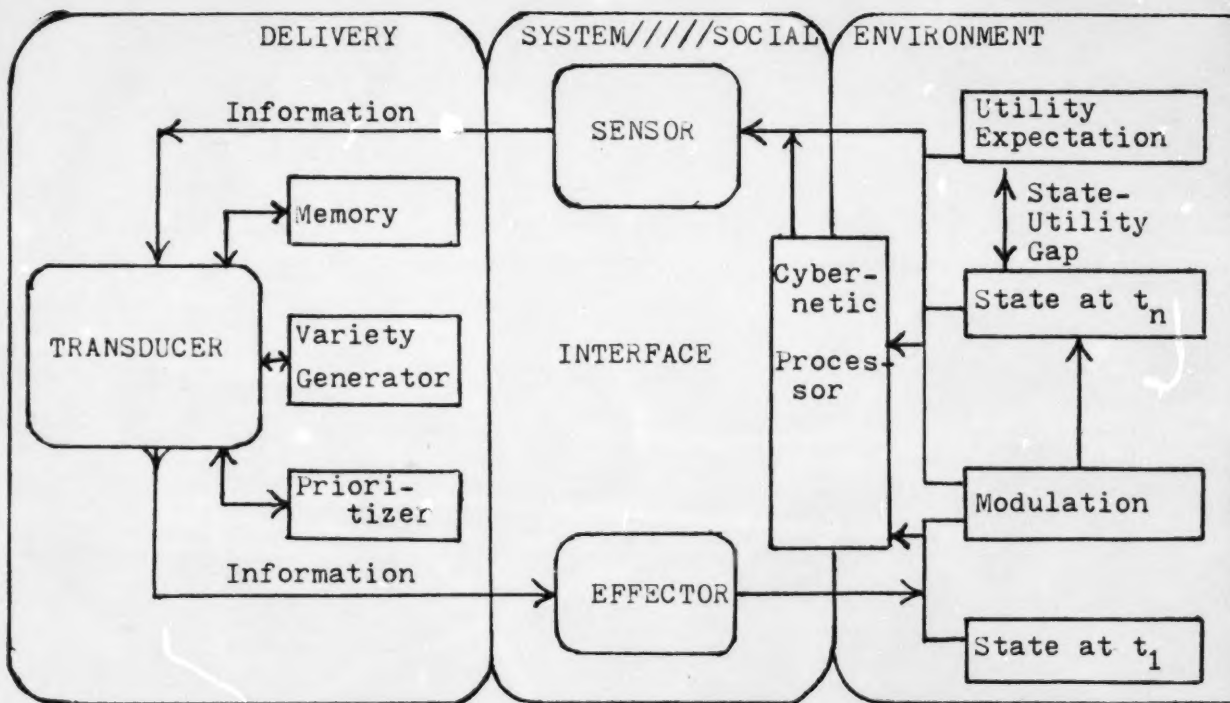


Figure 1: Model of a Viable, Utility-Maximizing Human Delivery System

The key design principles just proposed will not be considered in detail at this point. They have been anticipated in the formulation of human system design and will be drawn upon in consideration of aspects of implementation. Given the present limitations of knowledge and experience, it is not assumed that the present listing is either complete or includes those principles which will eventually prove most important.

For what type of social system is the delivery system designed? And what is the proposed role or utility of education in such a society? These questions point to the crucial nature of our normative theory of society in formulating educational utilities of delivery systems. A basic assumption of normative social theory in our society is that all persons are created equal. Growing out of that assumption is the belief that it is desirable that educational institutions should promote equality of life chances among the members of the society.

But it is well known that traditional systems have regularly developed under the control of special interests and systematically get in the way of equality of life chances. The Supreme Court case Brown vs Board of Education had to do with one of those forms of institutionalized inequity. If educational delivery systems are to be supportive of the sort of society which we see as desirable, then the system can be expected to be a social stimulus and motivator in social movement toward a more desirable society. Thus another key design feature of the proposed educational system will be consistency with the ideal aspirations of our society growing from our shared normative theory.

The point of perspective within the general frame developed above is among low-income older people. Both income and age are related to life chances. Low income reduces life chances; the very process of

growing older and the social institutions related to aging, for example retirement policies, have systematically reduced life chances for the aging. Such deprivation of life chances can certainly be expected to engender among low-income aging feelings of meaningless and powerlessness that characterize alienation. While alienation appears to be rather widespread in our society, it is of particular importance for groups with relatively low control of life chances, including low income older people. It can be expected that the design of delivery systems for lifelong learning that target low income older persons will promote processes that engender understandings and skills that help to increase powers of dealing with life chances and so become alienation reducing. In sum, one key design principle characterizing the system will be its supportiveness of utilities growing out of normative social theory.

It has been contended that key design principles grow in part out of the factual theory of system design leading to certain principles of internal design as they structure the system and its interface. They also grow in part out of the normative theory of the environing society. With these general aspects of system design in mind, we now turn to the process of specification of particular delivery systems.

Design Specification: Introduction

Then Aidan, who was present at the conference, said to the priest in question, 'It seems to me, brother, that you have been unreasonably harsh upon your ignorant hearers: you did not first offer them milk of simpler teaching, . . . until little by little, as they grew strong on the food. . . , they were capable of receiving more elaborate instruction. . . . All eyes turned on Aidan. . . . They agreed that he was worthy. . . . and that he was the man to send to instruct those ignorant unbelievers, since he had proved himself to be endowed

with the grace of discretion, which is the mother of all virtues.

Venerable Bede's History

The above quotation is from the Venerable Bede's History¹⁵ in which he tells of the seventh century A.D. efforts, at the request of King Oswald, to bring religious education to the English. In our jargon King Oswald had asked the elders to design a religious educational delivery system. The first person they sent came back reporting that he had not been successful because the English were "intractable, obstinate and uncivilized." Bede goes on to say: "It is related that there was a long discussion at the conference as to what ought to be done; for they were anxious to give that people the help it asked for and regretted that the preacher they had sent had not been accepted." The above quotation then follows.

Aidan may be seen as talking about designing a viable human system for the delivery of religious education to the English. In terms of the conceptualization being developed here, he was saying that they needed to know about the level of needs among the English (in our jargon, the work of the sensor), to formulate what was needed, "milk," (transducer), to "give" it to them (effector) and, as a result of that step, to use the results to go on "little by little" to more advanced instruction (cybernetic response). This analysis sets in our conceptual terms the insight of Aidan. His success is well known, proceeding later to sainthood.

We may now state our problem as that of formulating a useful way of thinking of about implementation of universalistic principles of design in particular courses of action. It does, indeed, seem useful to think

of the process as one extending over a general-particular continuous range from the universalistic principles of design through the intermediate steps to the particular behavior in the course of action. The general end corresponds to what we normally call 'theory' and the particular end, to what we call 'practice.' The in-between steps may be thought of as those steps or 'methods',¹⁶ that relate theory to practice and practice to theory. Thus the method is seen as a back-and-forth relationship; that is, method is seen as dialectical. The process of implementation may now be seen as a dialectical method of relating relevant theory to relevant practice in the pursuit of educational utilities. These will be called theory-based methods of practice. The implementation model is shown in Figure II.

Formulated in this way, the implementation process is only incidentally involved in particular concrete designs. Aidan conceived and carried out successfully a course of action, presumably with the benefit of a "common sense" equivalent of theory and downright native intelligence in developing methods that put his intentions into practice. He presumably was a good 'transducer.' No doubt able people had done similar things before and have done so since. One has to be impressed with the efforts of persons in the field of development of lifelong learning projects today. Hopefully theory-based method can help. The present formulation of the implementation process seeks to provide an analytic method which can make an incremental contribution to the validity and reliability of project implementation. It may be relatively more useful to educational administrators as they design and operate systems. The analysis will focus upon method and will use particular project activities as illustrations of implementation.

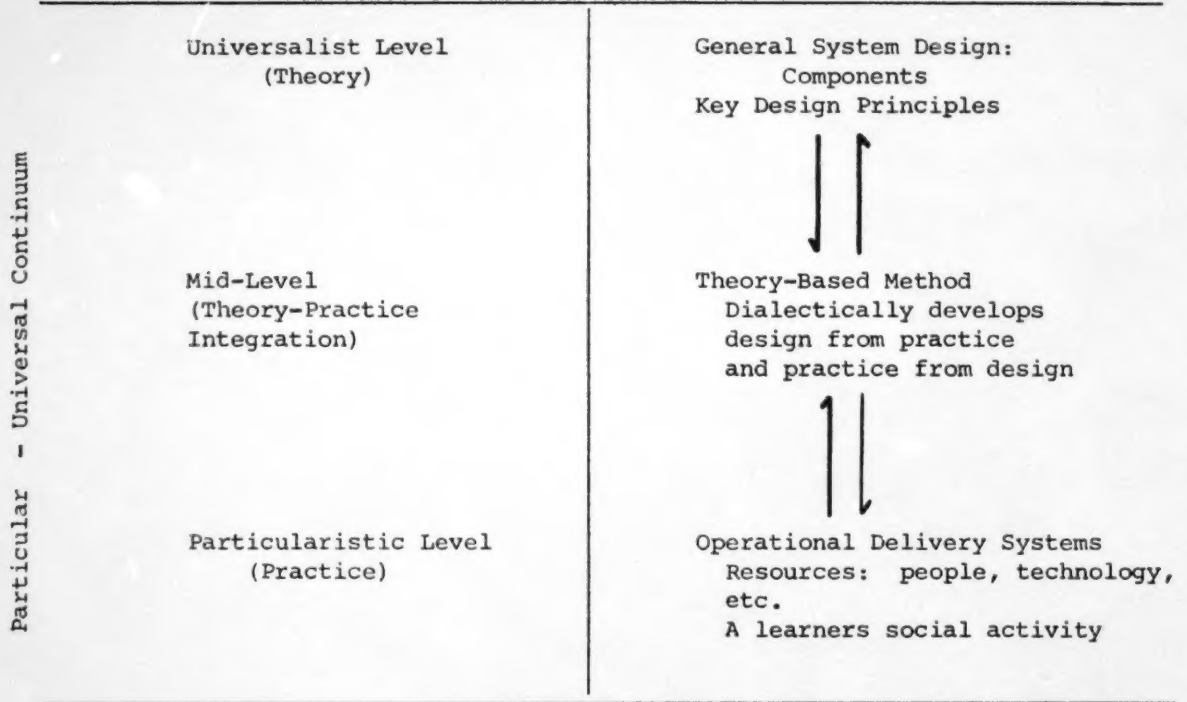


FIGURE II: Model of Delivery System Development

The way is left open to new approaches as, in the words of St. Aidan,
 "little by little (we) grow more strong."

Design and Method in Implementation

Theory-based methods of practice may be applied with each of the design components and the design in total. First the sensor receives information from the environment. Increasing attention to indicators of social needs has been developed in recent years and the body of data is increasing. In education the National Center for Education Statistics is a case in point. Theory is useful in formulating criterion-related indicators that generate information for processing through the sensor. Needs assessment surveys may be addressed to objective conditions and to subjective views of what

is needed. They tend to be more helpful in sensing macro states of affairs. The administrator working with a particular group of, let us say, low income older people with limits to formal verbal expression, will need to devise special methods by which the sensor maintains functional information gathering competence with low dependence on written response. One of the students in the seminar tells how she is able to obtain information through an intermediary group which has a range of informal face-to-face contacts. We have observed two Portugese-speaking women in their seventies who were particularly insightful in assessing the needs of immigrant Portugese and providing liaison with the service center in which they worked. They also served at the effector level in helping new immigrants to learn basic survival skills. They gave no evidence, and perhaps just as well, that they thought of themselves as "teaching" their co-ethnics survival skills. We shall return to the usefulness of interaction of small informal groups in program development.

Methods, such as those just mentioned, serve also to illustrate (and need to be guided by) the key design principles, simplicity, flexibility, etc. with short two-way communication channels. At the same time the administrator needs to be particularly ingenious in devising methods which protect the delivery system against errors, abuse and overloading. Flexibility and acceptability criteria may prove to be particularly helpful here. Again a seminar student has reported instances of ways in which clients at the interface can serve as "my thermometer" in assessing acceptability and in sorting priorities when a limited staff could easily become overloaded.

A particularly troublesome task is one that has been called "reaching the unreached."¹⁷ In this study they stated as "one of our most important findings": "This is the importance of an interactive, grass-roots needs assessment process which lets people name their own needs through talking about their life situation, their problems, interests and concerns, and considering alternative actions." Not surprisingly in the light of our knowledge of group discussion in affecting the behavior of persons, they concluded: "In group interview process, we believe, is clearly one key in learning how to go about 'reaching the unreached.'" A member of the seminar has been experimenting with group discussion methods in seeking potential participants and their needs.

The transducer is, in a very real sense, the "brains" of the system. The term is drawn from scientific instrumentation and communication technology. The transducer serves to process information and control functional performance of the system. Thus the transducer receives information from the sensor, through use of theory-based methods, converts it to function-related alternatives (probabilities), orders them in terms of priorities (desirabilities) and converts them into "value-probability products" for implementation through the effector. Transductive methods need to draw upon factual theories from such fields as sociology, psychology, gerontology, economics and politics in formulating probabilities and normative theories, both from ethics and from social normative structures, in formulating desirabilities.¹⁸ Interactive grass-roots participation can add insight and relevance to this process.

All too often in conventional educational delivery systems the transduction process has been internal to the delivery system with limited client involvement. If the delivery system is to be one that helps to develop competence in control of life chances among the clients, it will be important that the clients be able to interact with and through the system in many ways in transductive formulation. Their insights about what is likely and worthwhile can be shared in a number of ways both formal and informal. Here again is participation as a key design principle. Such participation helps to provide to clients protection from what may be called, perhaps a bit unkindly but not uncharitably, the "arrogance" of the professional.

The participation principle is also important at the effector stage. Here the system again needs to act in such ways as meet the acceptability principle. Experience makes a difference here too. At elementary and secondary school levels, the effector is often primarily concerned with providing experience from which learning can grow. Adults, particularly the elderly, bring to learning a rich fund of experience from which they already have learned much. They may also have been spared some of the more debilitating aspects of formal education. In this connection Whitehead in his Aims of Education¹⁹ has observed: "This is the reason why uneducated clever women, who have seen much of the world, are in middle life so much the most cultured part of the community." For this reason method at the effector level, as at other levels, needs to give a great deal of attention to sharing of insight through dialogical teaching methods. Probably anyone who has taken part in such education has been impressed with the freshness of insight that is often available from older learners and the resentment

that can be expressed when the dignity of their experience is not recognized. (It is sad to see persons who have been taught to denigrate their experience.) This dialogical method is simply another application of the participation principle.

We have now sketched briefly the use of theory-based methods of practice at the three component points of the delivery system and made a few illustrative comments. The interface is the place at which the system as a whole comes in contact with the social environment in all its complexity. We have seen the interface as an area in which there is expected to be a rich process of two-way direct exchange of information and insight. This is where cybernetic processes can be expected to be at work and, when working well, to serve to reduce the gap between the learning level state resulting from the effector and the learning utility sought. When those conditions are met at the interface, we see a viable self-regulation process based upon a system which itself has learning competence.

This competence of the system to learn is of special educational significance. For the very contact of persons with a system of that sort at the interface, or in the sub-processes of the system, provides learners with the opportunity to experience self-maturing competence thus opening the possibility of self-maturing in their own lives. In this way the system has the potential for itself being intrinsically educative; rather than being an education system, it can be an educational system. This aspect is especially relevant to development of personal ability to control ones own life chances. Again, just as one does not need to know all about how the typewriter works to type these words, so also the participant does not need to understand all about

the system design in order to learn. Probably the most crucial feature of method at the interface is the authenticity of the system-environment dialogical relationship. Genuine experience and genuine learning seem to go hand in hand.

The interface is set in space and time. Traditional educational delivery systems have built into their design constraints assumptions about space and time. For example, there regularly is the assumption that learners will go considerable distances in order to gain access to the system, normally buildings where the deliverers are housed. These arrangements seem to serve the system more than the learners. The travel makes considerable economic and physical demands upon the travellers. These demands are especially constraining upon low income persons and the elderly as well as the physically handicapped. In addition to the costs of conveyances, there are the physical problems of getting in and out of conveyances and buildings which have been designed with steps and other hinderances to access. The physical distance also violates the design principle of two-way, short lines of communication to permit immediate interaction.

Those who have not been reached by educational services often harbor negative concepts of what, from past experience, they have come to know as "education." Education delivered in the conventional spacial manner is only too likely to trigger those negative images and add social and psychological hinderances to the economic and physical blocks already noted. All of these conditions make serious and unnecessary demands upon the motivations and abilities of potential learners. The design principles advanced above imply a thorough-going examination of the

assumptions about the spacial ecology of the interface. This aspect of design is clearly related to reaching the unreached.

Time is also important. Traditionally education delivery has been designed for persons who for the most part did not have work roles -- except for those working in the delivery system. Consequently the service system operated normally during the daytime with some activities at other times for a few special groups such as immigrants and for leisure-recreational purposes. Serious attention to lifelong learning needs to involve a basic examination of time assumptions both in terms of time of day and variations from day to day. "Sandwich education" is but one example of time adaptation to the needs of combined learning and working roles. Such design principles as flexibility, acceptability and client participation in decision making bear upon time arrangements.

These few comments are probably sufficient to point up the importance and diversity of variations in the space-time ecology of the interface. These considerations should be programmed into the transducer decision process utilizing participation of the actual and potential learners as well as the growing literature of the field.

We earlier assumed the need for linkages among the several types of human delivery systems whether they be education, health, welfare or other. This aspect of design is not central to the present formulation other than to point to the need for linkages at the interface. Milsum²⁰ in his paper on "Systems Thinking about Health" has pointed to the need for integrating the various human services through government around concepts of quality of life and human potential.

Now one final possible feature of the interface. We have already assumed that typically there will be multiple concomitant interchanges along the interface. The present illustration is but one of those possibilities. In the vernacular it can be called a "sump-pump." The proposed design is based upon reference group theory. It is known that persons are often willing to be influenced by significant others. Persons participating in the delivery system along the interface have the potential for becoming significant reference persons for other "unreached" persons in the environing society. We are currently experimenting with such a mechanism in a project at the State University of New York at Buffalo. This pool of reference persons has the potential of bearing information to the environment and back. In this way new needs may be sensed and responded to. This automatic-like sensing of environmental need and responding may be seen as a sump-pump-like process. It senses need and can automatically respond to need. As already stated, this method can be supplemented with other methods including more formal ones. It is provided here as an example of a reference-group-theory-based method of practice in responding to environmental function-related needs.

The complexity of the many relationships may be conceptualized and represented symbolically in a variety of ways. A group of students in the seminar experimented with formulation of such a conceptualization. It is shown in Figure III. They characterized it in their report as "only one of the many formats that could be devised."²¹ It is presented here as such an illustration. They went on to formulate a seven phase sequential design with the following phases: 1) Anticipation and Verification of a Problem, 2) Data Collection, 3) Academic Programming,

OPERATIONAL SYSTEM of Lifelong Ed. goals, assumptions, guiding principles, forms of learning

Situation-structures of learning

Management of Lifelong Ed.

Technology of Lifelong Ed.

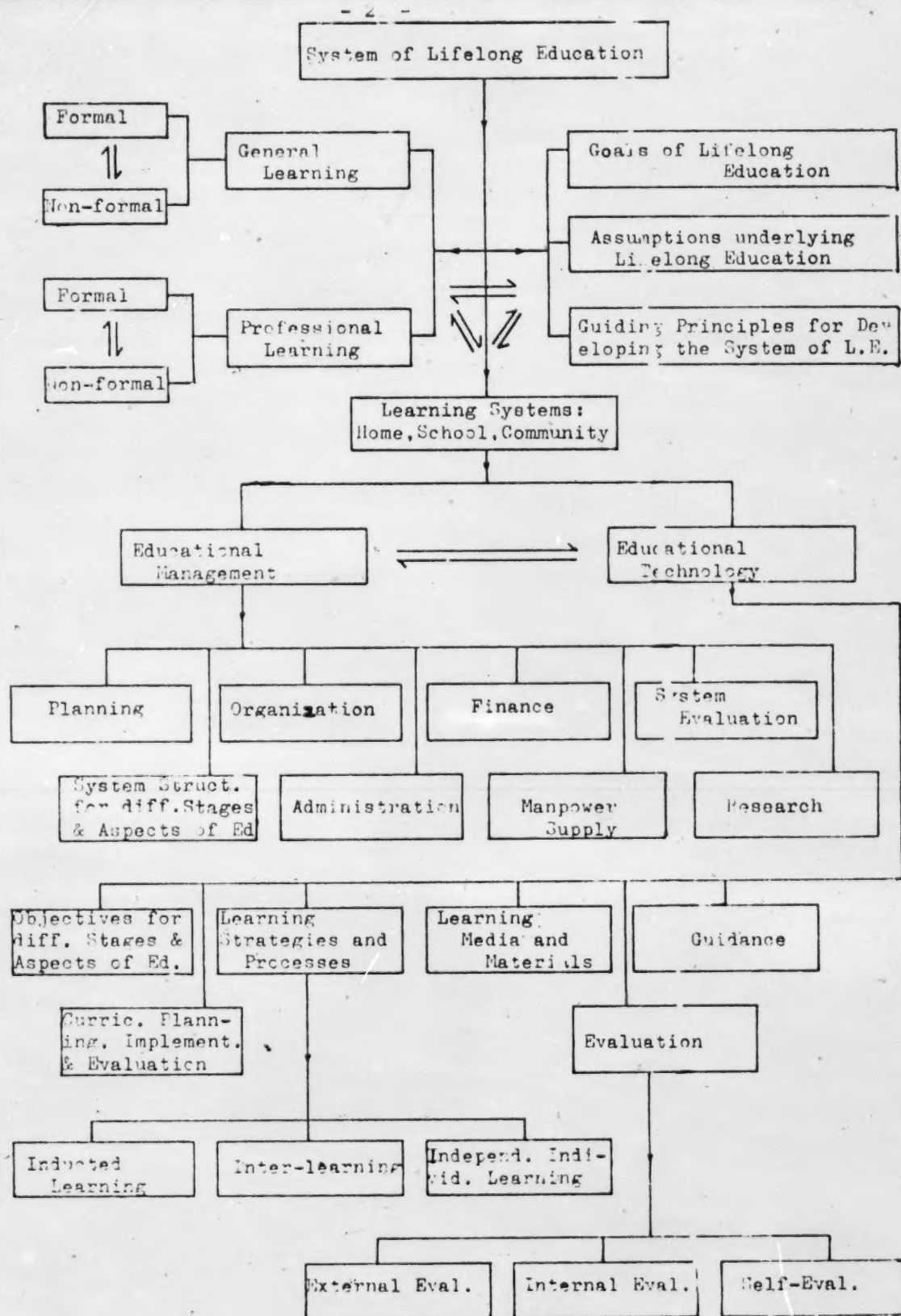
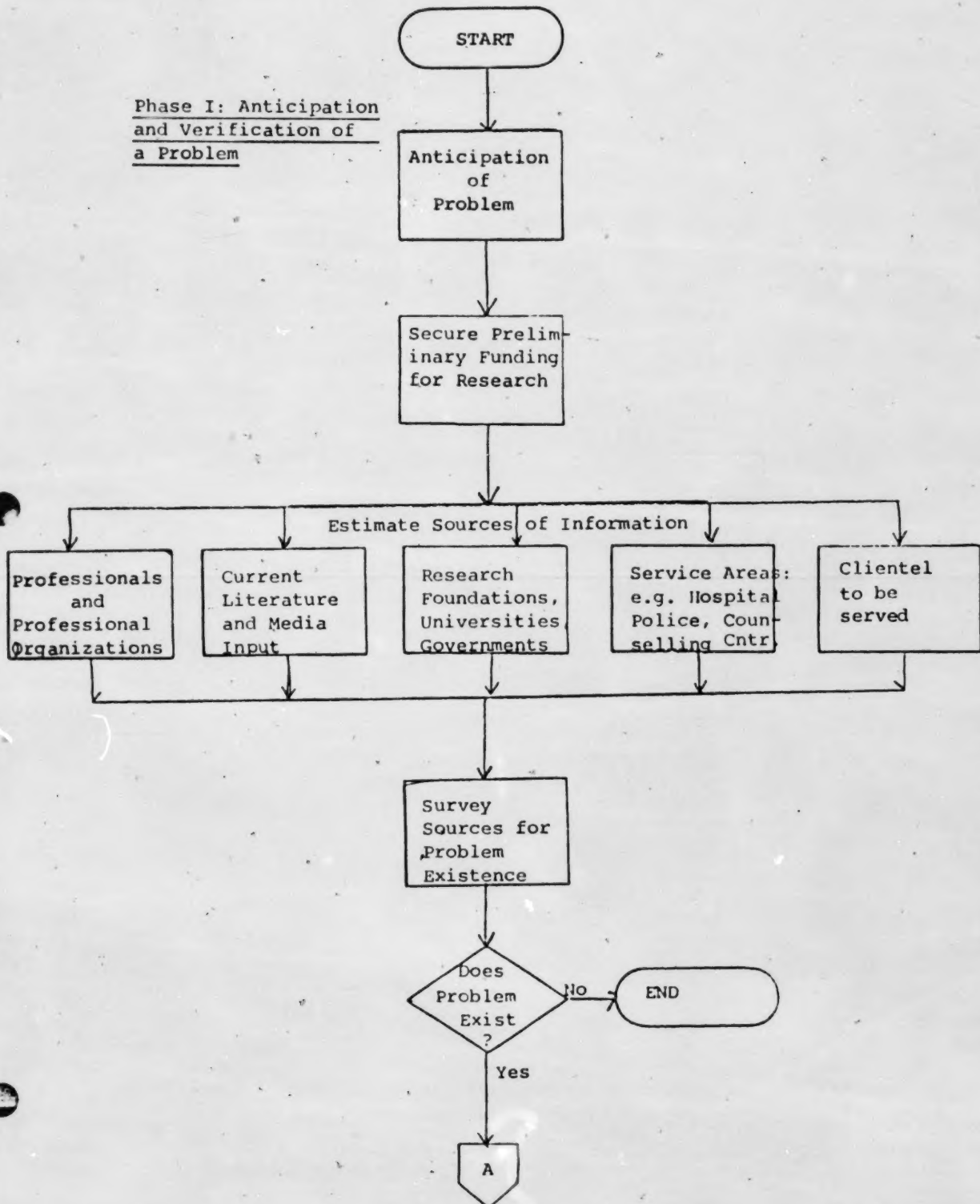


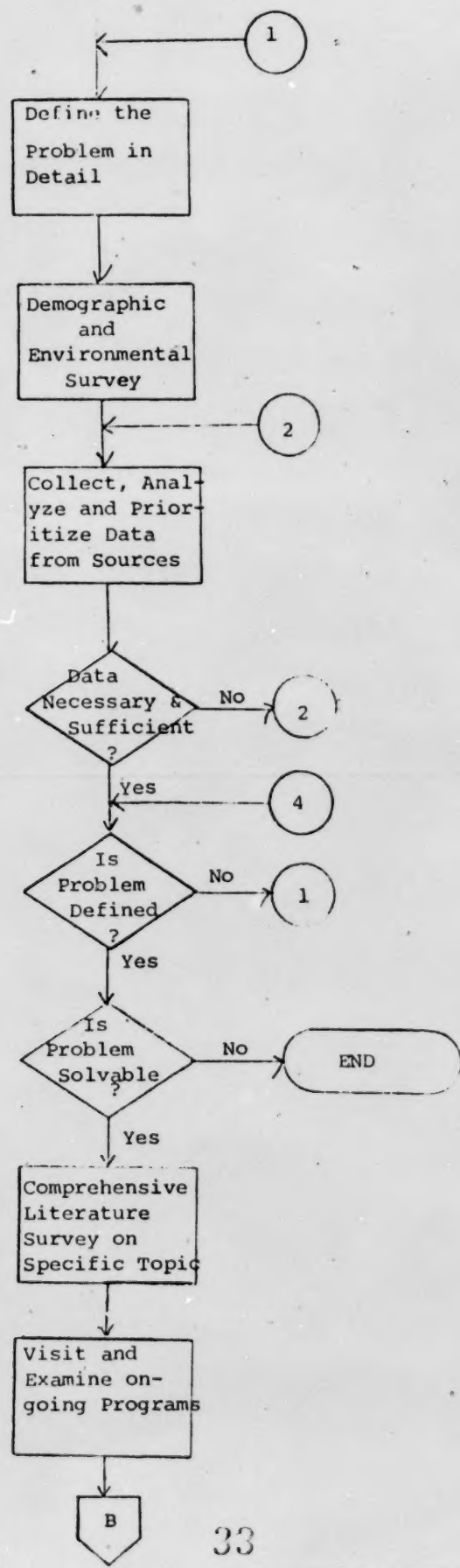
Figure III. Diagram of Possible Components of a System for Lifelong Learning *

* The sign $\rightleftarrows$ means interaction between two entities

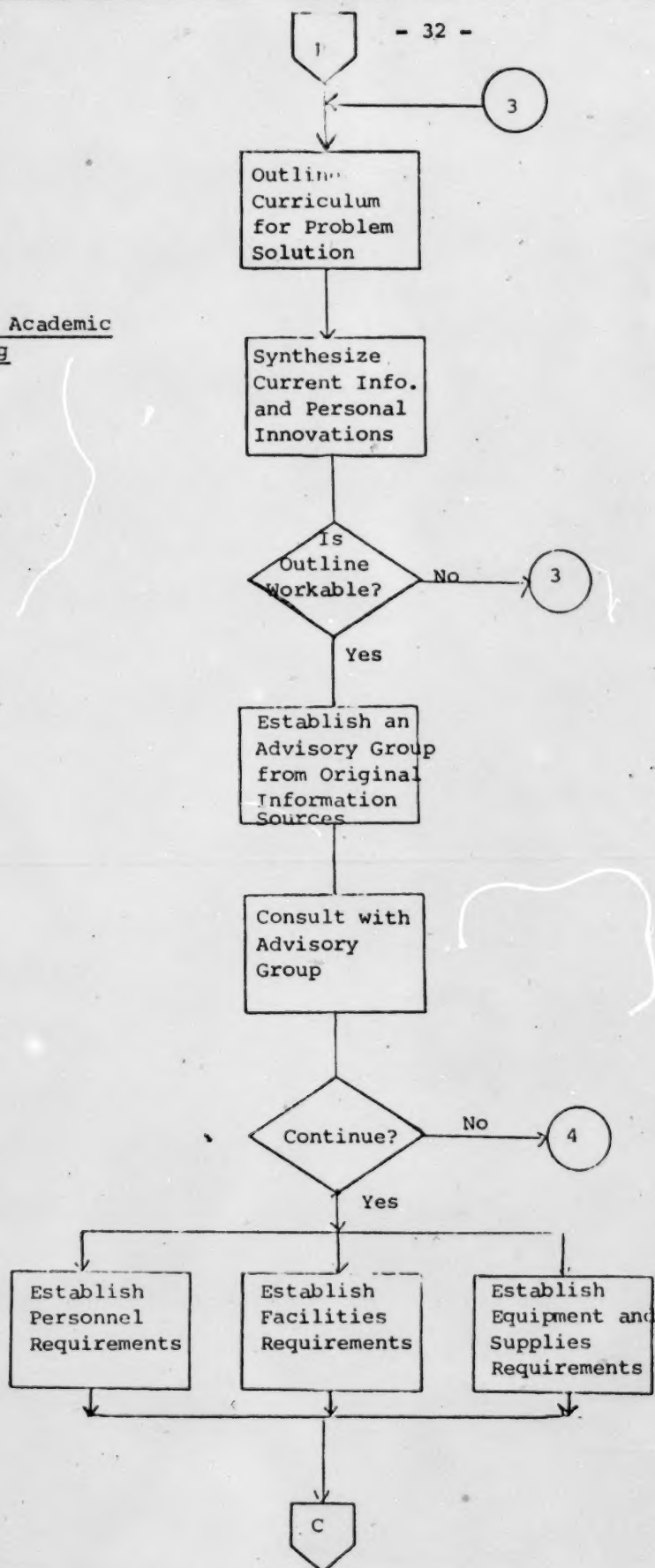
Figure IV. Diagram of a Possible Delivery System



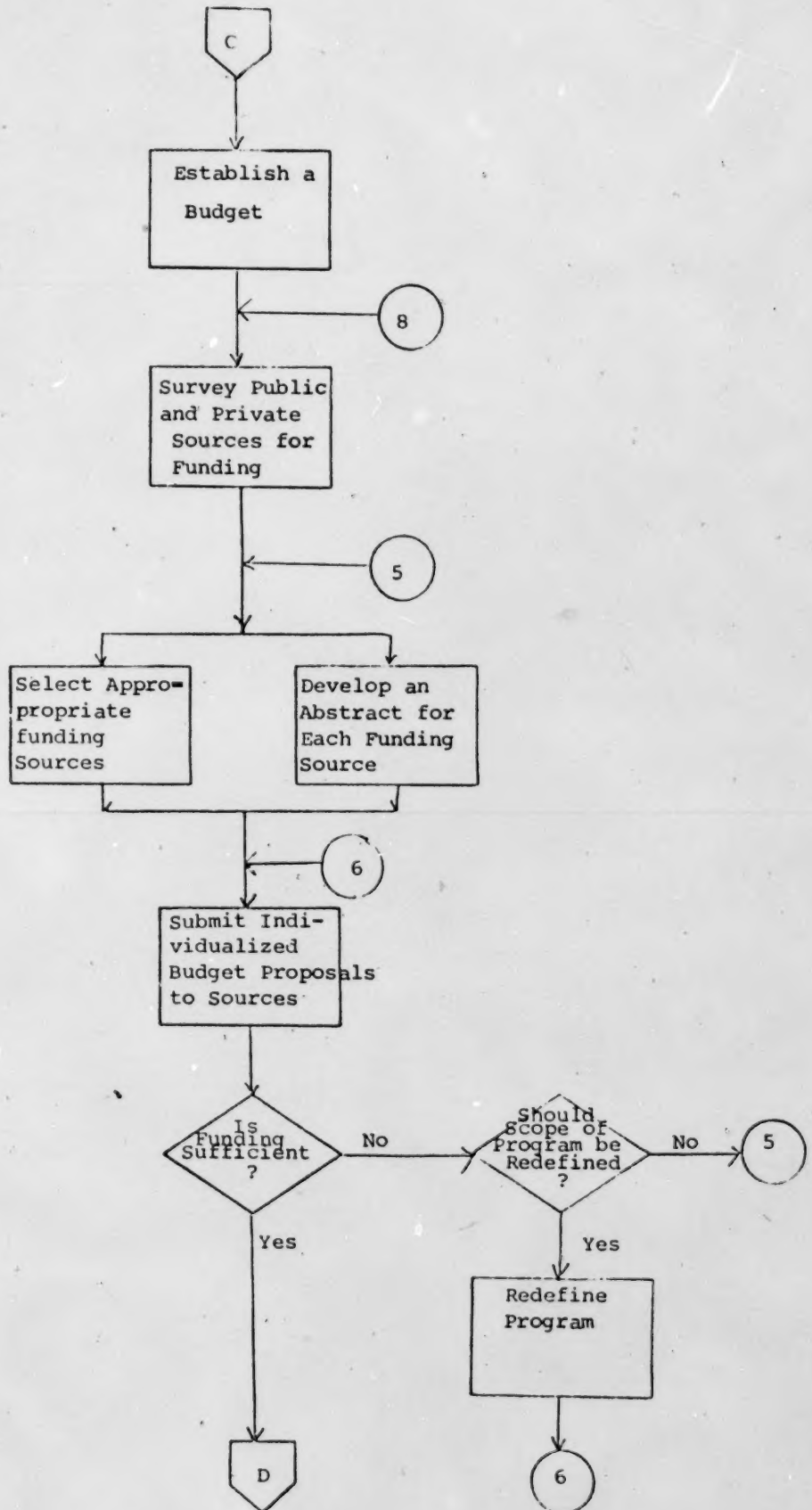
Phase II: Data
Collection



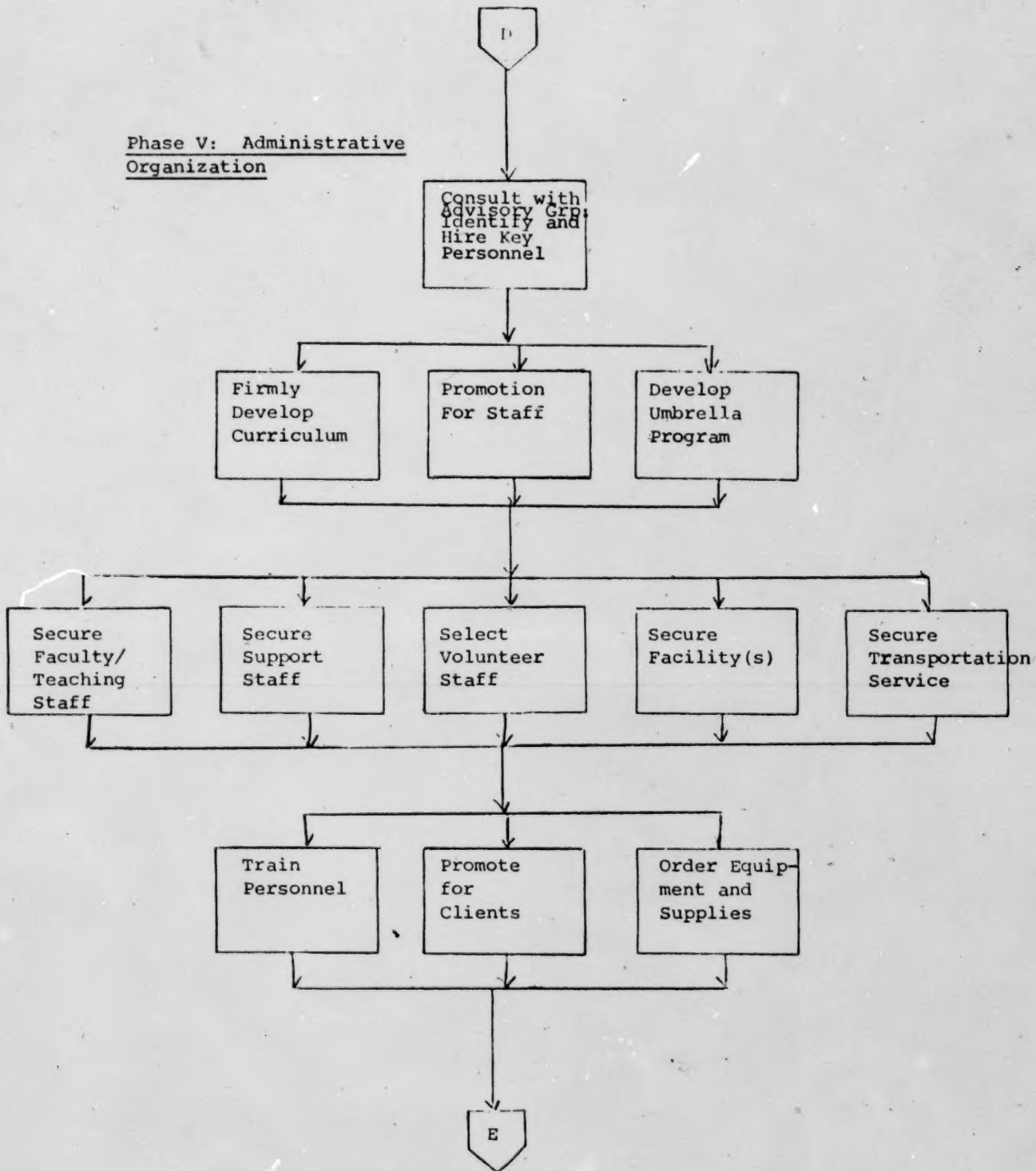
Phase III: Academic
Programming



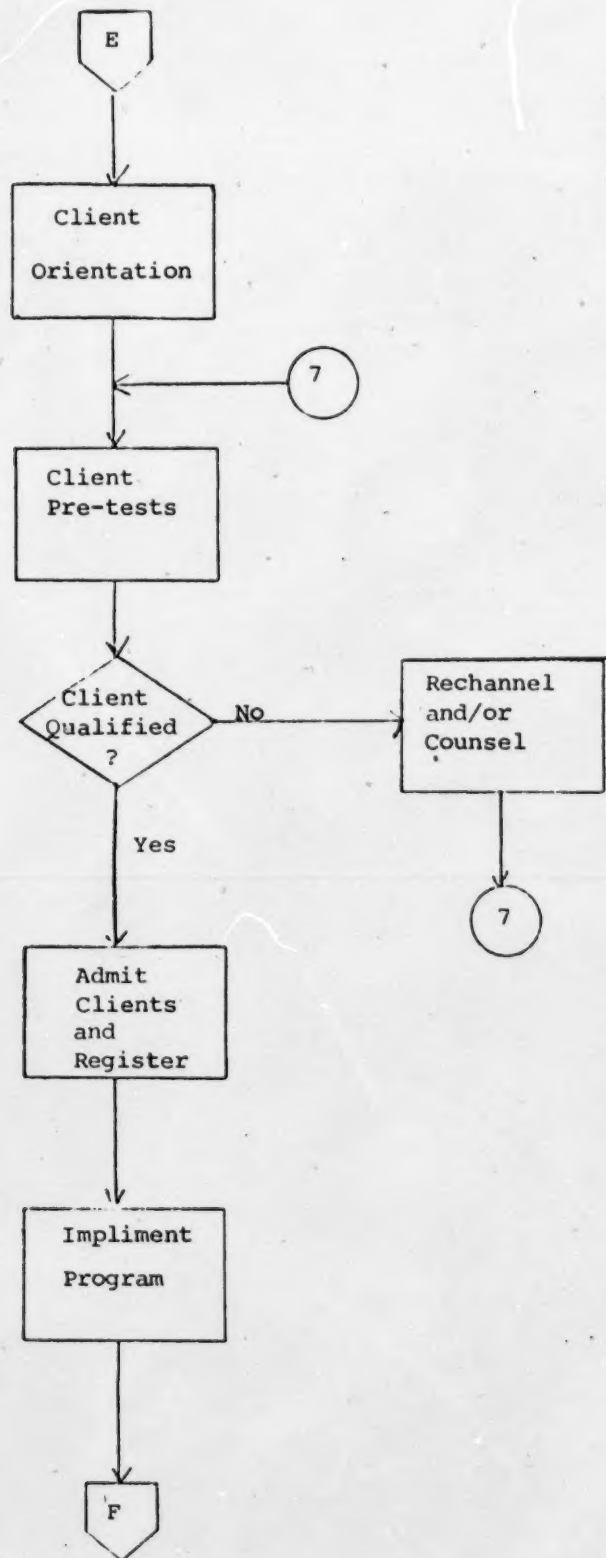
Phase IV: Budget



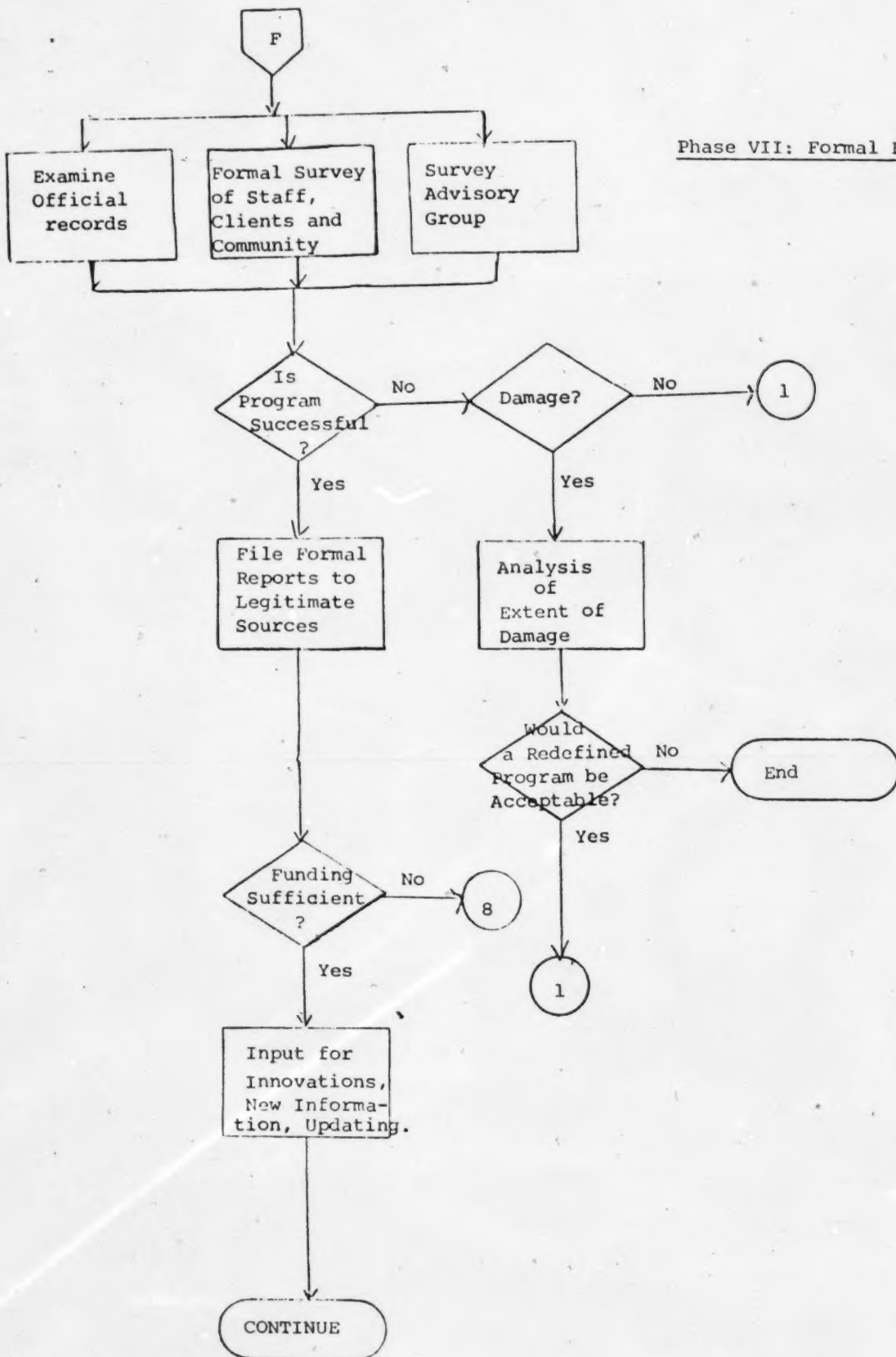
Phase V: Administrative
Organization



Phase VI: Initial
Client Involvement
and Implementation



Phase VII: Formal Evaluation



4) Budget, 5) Administrative Organization, 6) Implementation, 7) Formal Evaluation. The phases are shown in Figure IV. These formats are advanced as potentially useful for refinement through experience.

Implications for Research and Development

There is already a considerable body of research and theory that serves as a basis for educational system design and for strategies of development. A highly suggestive study is the UNESCO report Learning to Be.²² The report includes the following cogent observation (p. 144):

The future of education lies in devising educational institutions which combine industrial or technological efficiency, centered on the acquisition of knowledge, with the vitality of creative groups whose action will enable human relations to evolve.

Are these two propositions incompatible?

Rationalization of types and methods of pedagogic action, utilization of mass-communication technologies and introduction of cybernetic principles would seem to be conducive to stimulating individualization and awakening consciousness. They might also lead to increasing sociability, strengthening learners' independence and providing them with better weapons to seek more just social patterns, new conceptions of power and authority, and more effective means of communication and participation.

The future belongs to those able to unite criticism, democratic participation and imagination with the power residing in operational, scientific and rational organization, so as to evoke the latent resources and potential energies dwelling deep within the peoples.

Illustrative of efforts to conceptualize operational programs of lifelong learning is Towards a Conceptual Model of Life-long Education.²³

There is a beginning literature on design of delivery systems. Reference has already been made to Simon's proposals for a science of design.²⁴

Closer to our present purposes (also based in part on Simon's formulation) is Studer's work.²⁵ Reference has already been made to work on

development of basic design characteristics.²⁶ A comprehensive overview and perspective on lifelong learning together with recommendations for policy action is the U. S. Office of Education report Lifelong Learning and Public Policy.²⁷ Banathy²⁸ has contributed to application of systems analysis to educational development.

The present paper is seen as a step toward greater conceptual rigor in formulating design of educational delivery with special attention to lifelong learning, especially as it may relate to low-income elderly.

All of the sources cited above are toward the universalistic end of the universalistic-particularistic continuum as formulated in Figure II on page 21. While the sources cited may provide useful leads for further logical development and inquiry, they do not meet the needs of disciplined inquiry as described by Cronbach and Suppes.²⁹ The logic needs to be extended to more fully developed designs to permit testing. Some thoughts in this direction have been provided in the section on design implementation. Disciplined inquiry is basic to development of design theory in education and to the development of delivery systems grounded in theory-based method. This line of investigation is directed toward total program formulation and evaluation. That task poses enormous conceptual and methodological problems, especially when they are designed for the level of complexity of functioning proposed here. Case and ethnographic methods may prove useful for theory formulation and refinement and for hypothesis development in moving to more nomothetic designs of inquiry.

Distinctions have been made between policy or decision oriented research and inference or conclusion oriented research. Another useful

distinction is between cross sectional research, comparing variables at a point in time, and longitudinal, comparing relationships of variables over time. The resulting four types of research are shown in Figure V. Types I and III are always in immediate demand to meet the needs of administrators. However the contention here is that Types II and IV are very urgently needed and priority may very well be given to them.

Decision	I	III
Conclusion	II	IV
	Cross sectional	Longitudinal

Figure V. Types of Research

Policy and program development take time. Hence longitudinal designs are more appropriate to grounded conclusions than are cross sectional. In the past all too many fallacious conclusions have been drawn by assuming that cross sectional relationships hold longitudinally. It may be called the "fallacy of misplaced conclusions." But longitudinal studies take time and are relatively more expensive. The rewards system for both professors and students in universities stack the odds against longitudinal study and helps to promote the fallacy of misplaced conclusions. This line of reasoning does not permit us to be very

sanguine about Types III and IV research in the universities. In recent years experimental relationships between schools and universities and the federally supported area laboratories have helped to promote longitudinal investigation in realistic settings. More devices of those sorts are needed in pursuit of inquiry about the fruitfulness of alternative delivery systems.

There are many other less global while important areas of research having to do with how adults learn, what life events trigger motivation to learn, how unlearning takes place, the effects of peers in learning process of adults and the role of cultural variables, such as ideology, institutionalized expectations and stereotypes about education, in promoting and inhibiting education. What teaching and learning styles are related to what types of outcomes? What differences are associated with social and economic status and with changes across the life span?

What appear to be the most useful conceptualizations give coherence to what we think we know? What education/design theory seems to have validity? What hypotheses flow from such an approximation to valid theory? Would it support such hypotheses as:

Utility of design is a function of social relationships of learners.

Utility-maximizing is a direct function of the negentropic status of the system.

Conclusion

There was a time when education was seen as a task of the Common School preparing the young to read, write and figure. During the last century it has been extended to the first two and half decades of life.

That preparation has come to be a preparation for life and typically has taken place during the day in rooms/buildings set aside for that purpose to which the young come during the years before they take on the serious duties of life. It assumes that the young can be, on the whole, once and for all prepared for the responsibilities of life.

That type of institution is becoming out of touch with the needs of a complex and aging society. The young person of twenty years of age in 1980 can be expected to be still actively engaged in the responsibilities of life at the middle of the twenty-first century. It now appears patently ridiculous to think that a young person can today be equipped to deal with all the novelties of 2050. Most of those educated about 1920 have much to learn about life in 1980. Many needs have been among us right along but have either not been attended to or dealt with rather incidentally as extensions of conventional elementary-secondary-higher education. As the proportion of persons in the total population over the age served by those schools increases (and especially the increasing proportion over age 65) and as social sensativity to the unmet needs for lifelong learning rises, the need for conscious design of lifelong institutions of learning increases. This paper, growing out of a seminar on Design of Educational Delivery Systems for Lifelong Learning, is intended to promote that conscious attention to design.

Three general areas have been identified, namely, the delivery system, the environing society and the interface between them. The delivery system has been conceptualized as an interactive, self-regulating system with the following components: (1) a sensor which

receives information from the environment, (2) a transducer which uses the information to generate and prioritize alternatives and allocate resources for service delivery (of course, the transducer is also involved in all aspects of adaptation to the environment) and (3) an effector which converts preferred alternatives into operational programs for learners. Linkages at the interface between sensor and effector have been given attention as they contribute to the cybernetic potential of the system--as they help to form an adaptive learning system. One example of possible social technology at the interface has been characterized as an education "sump-pump." We have also pointed to the need for linkage with other human service systems.

Design has been seen as a relatively universalistic aspect of the development of lifelong learning projects and institutions. Implementation has been formulated toward the particularistic end of the universal-particular continuum. It is proposed that theory-based method can serve dialectically to link conceptual design and the action of implementation. Only a few examples have been advanced to show how the process can work out in practice. Ultimately practice probably has to rely heavily on what Bede called the "grace of discretion."

Finally some suggestions have been advanced for areas of research that can make available more information and more valid theory as resources in design formulation and in program implementation.

The ideas presented here are but preliminary rough approximations growing out of a seminar on design of lifelong learning delivery systems. Hopefully these ideas, as they are exposed to critical examination, will be revised and refined making possible more conscious attention to the development of policy and programs for lifelong learning.

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¹Funded by a grant from the HEW Office of the Aging under Title IV-A through the Multidisciplinary Center for the Study of Aging at the State University of New York at Buffalo. We are indebted to the students in the seminars for many ideas and critical suggestions.

²D. O. Cowgill and L. D. Holmes, Aging and Modernization (New York: Appleton-Century-Crofts, 1972).

³Norman D. Kurland, "A National Strategy for Lifelong Learning," Phi Delta Kappan (Vol. 59, No. 6, Feb. 1978), pp. 385-389.

⁴A useful report is: Robin M. Henig, "Exposing the Myth of Senility," The New York Times Magazine (Dec. 3, 1978), pp. 158-167.

⁵Kurland, loc. cit.

⁶Bogdan Suchodolski, "The Future of Higher Education," Polish Facts and Figures (No. 914, August 1973), pp. 6-7.

⁷Herbert A. Simon, The Sciences of the Artificial (Cambridge, Mass.: M.I.T. Press, 1969), especially p. 4.

⁸It is recognized that artificial systems include simulations of human systems, as defined here, for example, models of artificial intelligence. These would seem to differ in degree of particularism-universalism, rather than kind. All artificial systems, including human systems, are seen as open to such variation. Indeed, the present purpose is to formulate a relatively universalistic human system design with educational utility across the life span.

⁹For further development of the transduction process see: R. Oliver Gibson, "The Transduction Process and Organization of Education" in Troy V. McKelvey (ed.), Metropolitan School Organization, Vol. 2 (Berkeley: McCutchan), pp. 92-104. Further development of the concept of critical consciousness of intention-outcome gap appears in R. Oliver Gibson and Richard A. King, "An Approach to Conceptualizing Competency of Performance," Educational Administration Quarterly (Vol. 13, No. 3, Fall 1977), pp. 17-30.

¹⁰Those interested in a further development of that relationship may refer to R. Oliver Gibson and Herold C. Hunt, The School Personnel Administrator (Boston: Houghton Mifflin, 1965), especially the concept of value-probability product, pp. 70-74, and R. Oliver Gibson, "A General Systems Approach to Decision-Making in Schools," The Journal of Educational Administration (Vol. 6, No. 1, May 1968), pp. 13-32. In essence, the position taken is that, while value cannot be deduced from

fact, the nexus of fact and value lies in the compatibility of the assumptions of factual and normative theory. In this way the memory can develop increasing certainty about the interventions which have relatively greater probability of leading to valued outcomes, namely, utility accomplishment. The usual recommendations that emerge from research make little, if any, use of this distinction thus limiting the usefulness of probabilities in maximizing utility.

¹¹ It is understood that James Conant faced this problem in the Manhattan Project in developing the atomic bomb, i.e., whether to test one possibility after the other or to proceed on multiple fronts at the same time. It is our understanding that, time having high utility for success in World War II, the latter parallel approach was the preferred one.

¹² Simon, ibid., "The Organization of Memory," pp. 41-52.

¹³ Richard A. Johnson, Fremont E. Kast and James E. Rosenzweig, The Theory and Management of Systems (McGraw-Hill, 1963), ch. 13, pp. 337-364.

¹⁴ M. Kochen and K. W. Deutsch, "Delegation and Control in Organizations with Varying Degrees of Decentralization," Behavioral Science (Vol. 22, 1977), p. 269.

¹⁵ Bertram Colgrove and R. A. B. Mynors (eds.), Bede's Ecclesiastical History of the English People (Oxford: At the Clarendon Press, 1969), p. 229.

¹⁶ "Method" is used here in the sense of "the procedure used in the pursuit of an objective."

¹⁷ Kathleen Rockhill and William Rivera, Reaching the Unreached: A Qualitative Approach to Assessing Participation Potential, (Mimeo, 1977). We appreciate the kindness of Ann Fales of OISE in bringing this study to our attention.

¹⁸ A very useful general source is: R. H. Dare, ed., Foundations of Lifelong Education, UNESCO Institute for Education (New York: Pergamon Press, 1976). Sources which focus upon education and provide useful bibliographies include: Roger Hiemstra, Lifelong Learning, (Lincoln, Neb.: Professional Educators Publications, Inc. 1976); Sir Richard Livingstone, On Education (New York: Macmillan, 1945); J. R. Kidd, How Adults Learn (New York: Association Press, 1973); John Lowe, The Education of Adults: A World Perspective (Paris: UNESCO, 1975); A. Tough, The Adults Learning Projects (Toronto: Ontario Institute for Studies in Education, 1971). Sources which provide social perspective together with extensive bibliographic information include: Jon Hendricks and C. Davis Hendricks, Aging in Mass Society (Cambridge, Mass.: Winthrop Publishers, Inc., 1977); Bernice L. Neugarten, ed., Middle Age and Aging (Chicago: University of Chicago Press, 1968); Irving Rosow, Socialization to Old Age (Berkeley, Calif.: University of California Press, 1974).

Resource allocation is treated extensively in Douglas M. Windham, Norman D. Kurland and Florence H. Levinsohn, eds., "Financing the Learning Society," School Review (Vol. 86, May 1978, No. 3).

¹⁹ A. N. Whitehead, The Aims of Education (New York: Mentor Books, 1949), p. 13.

²⁰ John H. Milsum, "Systems Thinking about Health," Proceedings, (Society for General Systems Research, 1975), pp. 159-164.

²¹ Cathy Ansuini, et. al., An Educational Delivery System for Lifelong Learning (Spring 1978, Mimeographed).

²² Edgar Faure, et. al., Learning to Be (Paris, UNESCO, 1972).

²³ George W. Parkyn, Towards a Conceptual Model of Life-long Education (Paris: UNESCO, 1973).

²⁴ Simon, op. cit.

²⁵ Raymond G. Studer, "Human Systems Design and the Management of Change," Yearbook of the Society for General Systems Research, Ludwig von Bertalanffy and Anatol Rapaport, eds. (Vol. XVI, 1971), pp. 131-143.

²⁶ Johnson, Kast and Rosenzweig, op. cit.

²⁷ U. S. Department of Health, Education, and Welfare, Lifelong Learning and Public Policy (No. 017-080-01847-1, Washington, D. C.: Government Printing Office, 1978).

²⁸ Bela H. Banathy, "On the Contribution of Systems Science to Educational Development," Proceedings, (Society for General Systems Research, 1976), pp. 225-235.

²⁹ Lee Cronbach and Patrick Suppes, eds., Research for Tomorrow's Schools: Disciplined Inquiry for Education (New York: Macmillan, 1969).